

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Currently Amended) An optical information recording medium comprising:  
a transparent substrate having a first surface and a second surface;  
a recording layer arranged on the first surface of the transparent substrate,  
wherein

a hologram is recorded in the recording layer when a signal light and a reference light are incident from an incident side opposite to the transparent substrate,

a region in the recording layer, in which the hologram is recorded, contains portions of differing optical density and is conical, and

the optical density corresponding to the signal light in the region of the recording layer in which the hologram is recorded decreases from the incident side toward the transparent substrate; and

a reflection layer arranged on the second surface of the transparent substrate;  
wherein

the recording layer includes a high optical density layer and a low optical density layer corresponding to the signal light, and

the high optical density layer is arranged on the incident side relative to the low optical density layer.

2. - 5. (Cancelled)

6. (Original) The optical information recording medium according to claim 1,  
further comprising:

a groove that is arranged on the second surface of the transparent substrate to  
form a track,

wherein at a same depth position of the recording layer, the optical density of an  
area of the recording layer corresponding to the groove is lower than the optical density  
of other area.

7. (Original) The optical information recording medium according to claim 1,  
further comprising:

a groove that is arranged on the second surface of the transparent substrate to  
form a track,

wherein the recording layer includes areas having different optical densities at a  
same depth position, and

an area having a lower optical density is arranged at a nearer position to the  
groove than an area having a higher optical density.

8. (Currently Amended) An optical information recording medium comprising:

a transparent substrate having a first surface and a second surface;

a recording layer arranged on the first surface of the transparent substrate,

wherein

a hologram is recorded in the recording layer when a signal light and a  
reference light are incident from an incident side opposite to the transparent  
substrate,

a region in the recording layer, in which the hologram is recorded,  
contains portions of differing optical density and is conical, and

an optical density corresponding to the signal light in the region of a part of  
the recording layer in which the hologram is recorded decreases from the  
incident side toward the transparent substrate, and an optical density of a  
remaining part of the recording layer is uniform; and  
a reflection layer arranged on the second surface of the transparent substrate;  
wherein

the recording layer includes a high optical density layer and a low optical  
density layer corresponding to the signal light, and

the high optical density layer is arranged on the incident side relative to  
the low optical density layer.

9. (Previously Presented) An optical information recording medium comprising:  
a transparent substrate having a first surface and a second surface;  
a recording layer arranged on the first surface of the transparent substrate,  
wherein

a hologram is recorded in the recording layer when a signal light and a  
reference light are incident from an incident side opposite to the transparent  
substrate,

a region in the recording layer, in which the hologram is recorded,  
contains portions of differing optical density and is conical,

the recording layer includes a high optical density layer and a low optical  
density layer corresponding to the signal light,

the high optical density layer is arranged on the incident side relative to the low optical density layer, and

the optical density corresponding to the signal light in the region of the recording layer in which the hologram is recorded decreases from the incident side toward the transparent substrate; and

a reflection layer arranged on the second surface of the transparent substrate.

10. (Withdrawn) A method of manufacturing an optical information recording medium that includes a recording layer in which a hologram is recorded and a transparent substrate that has a first surface and a second surface, the method comprising:

depositing a first recording film on the first surface of the transparent substrate; and

depositing a second recording film having a higher optical density than the first recording film on the first recording film.

11. (Withdrawn) A method of manufacturing an optical information recording medium that includes a recording layer in which a hologram is recorded and a transparent substrate that has a first surface and a second surface, the method comprising:

depositing the recording layer on the first surface of the transparent substrate; and

irradiating a light to decrease an optical density on the recording layer from a side of the second surface of the transparent substrate.

12. (Withdrawn) A method of manufacturing an optical information recording medium that includes a recording layer in which a hologram is recorded and a transparent substrate, the method comprising:

depositing the recording layer on a surface of the transparent substrate; and  
doping a sensitizer into the recording layer from a light incident side.

13. (Previously Presented) A method of recording information in an optical information recording medium, the method comprising:

selecting an optical information recording medium, the medium comprising:

a transparent substrate having a first surface and a second surface;

a recording layer arranged on the first surface of the transparent substrate,

wherein

a hologram is recorded in the recording layer when a signal light and a reference light are incident from an incident side opposite to the transparent substrate,

a region in the recording layer, in which the hologram is recorded, contains portions of differing optical density and is conical, and

an optical density corresponding to the signal light in the region of the recording layer in which the hologram is recorded decreases from the incident side toward the transparent substrate; and

a reflection layer arranged on the second surface of the transparent substrate; and

recording the hologram in the recording layer by irradiating the optical information recording medium with the signal light and the reference light through a lens, wherein the optical density  $S(z)$  at a depth  $z$  in the recording layer is within a range expressed as

$$0.5 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2 \leq S(z) \leq 2.0 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2$$

where  $S_0$  is the optical density on a surface of the incident side of the recording layer at  $z=0$ ,  $n_1$  is a refractive index of the recording layer,  $A$  is a numerical aperture of the lens,  $r_0$  is a radius of a spot of the signal light on the surface of the incident side, and  $z$  is a distance from the surface of the incident side into the recording layer.

14. (Previously Presented) A method of recording information on an optical information recording medium, the method comprising:

selecting an optical information recording medium, the medium comprising:

a transparent substrate having a first surface and a second surface;

a recording layer arranged on the first surface of the transparent substrate,

wherein

a hologram is recorded in the recording layer when a signal light and a reference light are incident from an incident side opposite to the transparent substrate,

a region in the recording layer, in which the hologram is recorded, contains portions of differing optical density and is conical, and

an optical density corresponding to the signal light in the region of the recording layer in which the hologram is recorded decreases from the incident side toward the transparent substrate,

a reflection layer arranged on the second surface of the transparent substrate, and

a groove that is arranged on the second surface of the transparent substrate to form a track; and

recording the hologram in the recording layer by irradiating the optical information recording medium with the signal light and the reference light through a lens,

wherein the optical density  $S(r, z)$  at a predetermined position in the recording layer is within a range expressed as

$$0.5 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2 \exp\left(\frac{2r^2}{r_0^2}\right) \leq S(r, z) \leq 2.0 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2 \exp\left(\frac{2r^2}{r_0^2}\right)$$

where  $S_0$  is the optical density of a center of a spot of the signal light at  $r=0$  on a surface of the incident side of the recording layer at  $z=0$ ,  $n_1$  is a refractive index of the recording layer,  $A$  is a numerical aperture of the lens,  $r_0$  is a radius of the spot of the signal light on the surface of the incident side,  $r$  is a distance from the center of the spot in a direction across the track, and  $z$  is a distance from the surface of the incident side into the recording layer.

15. (Previously Presented) The optical information recording medium according to claim 1, wherein the hologram is recorded in the recording layer by a polarized collinear holographic method.

16. (Previously Presented) The optical information recording medium according to claim 8, wherein the hologram is recorded in the recording layer by a polarized collinear holographic method.

17. (Previously Presented) The optical information recording medium according to claim 9,

wherein the hologram is recorded in the recording layer by a polarized collinear holographic method.

18. (Previously Presented) The method of recording information in an optical information recording medium according to claim 13, wherein the hologram is recorded in the recording layer by a polarized collinear holographic method.

19. (Previously Presented) The method of recording information in an optical information recording medium according to claim 14, wherein the hologram is recorded in the recording layer by a polarized collinear holographic method.

20. (Previously Presented) The optical information recording medium according to claim 1, wherein the optical density  $S(z)$  at a depth  $z$  in the recording layer is within a range expressed as

$$0.5 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2 \leq S(z) \leq 2.0 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2$$



where  $S_0$  is the optical density on a surface of the incident side of the recording layer at  $z=0$ ,  $n_1$  is a refractive index of the recording layer,  $A$  is a numerical aperture of a lens,  $r_0$  is a radius of a spot of the signal light on the surface of the incident side, and  $z$  is a distance from the surface of the incident side into the recording layer.

21. (Previously Presented) The optical information recording medium according to claim 1, further comprising:

a groove that is arranged on the second surface of the transparent substrate to form a track, wherein

the optical density  $S(r, z)$  at a predetermined position in the recording layer is within a range expressed as

$$0.5 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2 \exp\left(\frac{2r^2}{r_0^2}\right) \leq S(r, z) \leq 2.0 \times \frac{S_0}{r_0^2} \left( r_0 - \frac{A/n_1}{\sqrt{1 - (A/n_1)^2}} z \right)^2 \exp\left(\frac{2r^2}{r_0^2}\right)$$

where  $S_0$  is the optical density of a center of a spot of the signal light at  $r=0$  on a surface of the incident side of the recording layer at  $z=0$ ,  $n_1$  is a refractive index of the recording layer,  $A$  is a numerical aperture of a lens,  $r_0$  is a radius of the spot of the signal light on the surface of the incident side,  $r$  is a distance from the center of the spot in a direction across the track, and  $z$  is a distance from the surface of the incident side into the recording layer.

22. (Previously Presented) The optical information recording medium according to claim 1, wherein the recording layer contains an initiator that absorbs light and

initiates a polymerization reaction, and the initiator is bis (2,6-difluoro-3-pyrrole phenyl) titanocene.

23. (Previously Presented) The optical information recording medium according to claim 1, wherein the recording layer contains an initiator that absorbs light and initiates a polymerization reaction, and a content of the initiator is 0.1 to 5.0 wt%.